

TABLE 2.—Free-air resultant winds (m. p. s.) during September, 1923.

Altitude. mi. s. l. (m.)	Broken Arrow, Okla. (233 meters).				Drexel, Nebr. (396 meters).				Due West, R. C. (217 meters).				Ellendale, N. Dak. (444 meters).				Groesbeck, Tex. (141 meters).				Royal Center, Ind. (225 meters).			
	Mean.		6-year mean.		Mean.		8-year mean.		Mean.		3-year mean.		Mean.		6-year mean.		Mean.		5-year mean.		Mean.		3-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface.....	S. 5° W.	3.6	S. 2° W.	3.6	S. 20° E.	1.1	S. 12° W.	1.8	N. 63° E.	3.0	N. 69° E.	2.4	S. 8° E.	0.1	N. 81° W.	0.8	S. 22° E.	3.0	S. 23° E.	2.0	S. 28° W.	1.6	S. 53° W.	1.5
250.....	S. 4° W.	3.7	S. 2° W.	3.7	S. 12° W.	2.3	S. 12° W.	2.6	N. 58° E.	3.1	N. 65° E.	2.1	S. 12° W.	0.8	S. 84° W.	1.0	S. 23° E.	3.9	S. 21° E.	2.8	S. 28° W.	1.9	S. 53° W.	1.8
500.....	S. 10° W.	4.9	S. 10° W.	5.1	S. 8° E.	2.3	S. 25° W.	3.6	N. 62° E.	3.5	N. 63° E.	2.5	S. 12° W.	0.8	S. 84° W.	1.0	S. 18° E.	4.8	S. 14° E.	4.1	S. 30° W.	3.6	S. 50° W.	3.3
750.....	S. 25° W.	5.4	S. 17° W.	5.8	S. 8° E.	3.0	S. 25° W.	4.0	N. 60° E.	3.9	N. 56° E.	2.4	S. 46° W.	2.2	S. 68° W.	1.7	S. 11° E.	4.8	S. 8° E.	4.6	S. 37° W.	3.9	S. 58° W.	4.1
1,000.....	S. 36° W.	5.2	S. 25° W.	5.8	S. 21° W.	3.2	S. 35° W.	4.0	N. 60° E.	3.6	N. 49° E.	2.4	S. 46° W.	2.5	S. 68° W.	2.5	S. 7° E.	4.6	S. 7° E.	4.7	S. 44° W.	5.3	S. 66° W.	4.9
1,250.....	S. 44° W.	5.0	S. 29° W.	5.8	S. 34° W.	3.0	S. 50° W.	4.2	N. 61° E.	3.2	N. 37° E.	2.5	S. 57° W.	2.9	S. 72° W.	3.0	S. 6° E.	4.6	S. 7° E.	4.8	S. 53° W.	6.0	S. 70° W.	5.9
1,500.....	S. 55° W.	5.1	S. 38° W.	5.8	S. 54° W.	3.2	S. 60° W.	4.9	N. 61° E.	2.7	N. 31° E.	2.7	S. 65° W.	3.6	S. 72° W.	2.9	S. 7° W.	4.5	S. 7° E.	4.6	S. 53° W.	6.5	S. 73° W.	6.6
2,000.....	S. 62° W.	5.0	S. 44° W.	6.0	S. 61° W.	4.1	S. 69° W.	5.8	N. 58° E.	1.1	N. 16° E.	2.1	S. 73° W.	4.4	S. 80° W.	5.3	S. 14° W.	3.7	S. 5° E.	4.2	S. 58° W.	9.1	S. 74° W.	8.7
2,500.....	S. 72° W.	5.8	S. 49° W.	5.4	S. 65° W.	7.4	S. 76° W.	7.5	N. 42° E.	0.1	N. 19° E.	1.9	N. 88° W.	7.2	S. 85° W.	7.3	S. 11° W.	3.5	S. 8° E.	4.2	S. 63° W.	10.5	S. 76° W.	10.3
3,000.....	S. 77° W.	7.1	S. 44° W.	6.1	S. 85° W.	8.6	S. 83° W.	9.8	S. 11° E.	1.4	N. 55° E.	2.0	N. 77° W.	8.9	S. 89° W.	9.3	S. 9° W.	3.6	S. 8° E.	4.2	S. 55° W.	13.7	S. 74° W.	12.7
3,500.....	S. 81° W.	5.3	S. 49° W.	5.3	N. 89° W.	11.0	N. 89° W.	10.5	S. 24° E.	2.3	N. 60° E.	3.5	N. 82° W.	10.1	S. 87° W.	10.7	S. 19° W.	3.0	S. 2° E.	3.8	S. 57° W.	12.6	S. 83° W.	12.5
4,000.....	S. 84° W.	7.6	S. 71° W.	6.9	N. 81° W.	8.5	N. 76° W.	12.1	N. 80° E.	0.9	N. 57° E.	4.0	N. 62° W.	13.0	N. 79° W.	12.5	S. 33° W.	5.0	S. 2° E.	4.4	S. 22° W.	13.3	N. 86° W.	10.0
4,500.....	N. 88° W.	11.1	S. 88° W.	8.8	N. 73° W.	10.4	N. 68° W.	13.8	.....	.....	.....	.....	N. 67° W.	10.3	N. 69° W.	13.6	S. 47° W.	6.7	S. 5°	6.9	.....	.....	.....	.....
5,000.....	S. 68° W.	12.5	N. 86° W.	13.8	N. 22° W.	13.6	N. 64° W.	15.7	.....	.....	.....	.....	N. 60° W.	15.0	N. 80° W.	13.7	N. 67° W.	3.6	S. 27° E.	5.5	.....	.....	.....	.....

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist, in Charge of Division.

PRESSURE AND WINDS.

The distribution of the atmospheric pressure during September, 1923, varied in some respects from that usually expected, the most important being the persistence of high pressure over the Northeastern States and the Canadian Maritime Provinces, where the change from the preceding month was nearly twice as great as normal. In other localities the changes from normal were comparatively small, though the averages for the different sections were above normal save for small areas in the Southeastern States, in the near Northwest, and along the California coast, where they were somewhat less than normal.

The cyclones were mainly unimportant, though there was rather persistent low pressure and cyclonic activity in the middle and southern Great Plains, where rainfall was frequent and heavy, particularly at the first of the month and again from about the 13th to 20th. Important cyclonic disturbances, at least from the precipitation standpoint, although there was no great depression of the barometer, occurred from the 16th to 18th, when moderately low pressure moved from the central Rocky Mountain region to the northward of Lake Superior. Precipitation from this cyclonic area covered wide areas in the Great Plains and adjacent region, and was particularly heavy in Oklahoma, eastern New Mexico, and portions of adjacent States. This was quickly followed by a second slight depression of the barometer that appeared on the morning of the 19th over Oklahoma and southern Kansas, and by the following morning had developed into a cyclonic storm of considerable proportions, central in Iowa, attended by precipitation over wide areas in the Great Plains, Mississippi Valley, and adjacent areas. This storm quickly diminished in force and during the following day or two lost its identity over the Northeastern States, although the accompanying precipitation was unusually widespread and frequently heavy over much of the country from the Mississippi River eastward, except in portions of the Gulf States.

The last decade of the month was mainly free from cyclonic storms of importance, save that from the 24th to 26th a small low area, but with a considerable depression of the barometer, moved from the vicinity of eastern Wyoming northward over the Dakotas and eastern Montana into the adjacent Canadian Provinces, attended by

a considerable rain area, with some local heavy falls for that region. A slight barometric depression over the eastern slope of the Rocky Mountains during the 27th to 29th gave some unusually heavy rains for the season of the year over that region and the adjacent Great Plains. At points in Wyoming, South Dakota, and Nebraska the total fall during this period ranged from 2 to 7 inches or more.

The most important anticyclone of the month moved into the upper Missouri Valley on the morning of the 10th, remaining nearly stationary, but increasing in magnitude for nearly 48 hours, when it gradually moved to the eastward, accompanied by clear and cool weather successively over northern and central districts from the Rocky Mountains to the Atlantic seaboard until the end of the second decade. During the last decade moderate anticyclonic conditions prevailed very generally over the northern and central districts from the Great Lakes eastward, attended mainly by fair weather and moderate temperature.

In the absence of important cyclones or anticyclones the air circulation was moderate and high winds or severe storms of any character were infrequent. A list of the most important storms of the month is given at the end of this section.

The average pressure for the month exhibited no strong barometric gradients and the prevailing wind directions were mainly variable, though usually from southerly points in the Great Plains, Mississippi Valley, and from the Lake region to New England, from northerly points over the Southeastern States, and variable in the far West.

TEMPERATURE.

September, 1923, was markedly free from sudden important temperature changes; in only a few instances were the 24-hour changes equal to or in excess of 20°, and these were confined to the more northern stations or to the western mountain districts, where day-to-day temperature changes are liable to be large occasionally at this period of the year.

The first few days of the month had seasonable temperatures in practically all parts of the country, save that on the 3d and 4th the warmest weather of the year was reported from points in the Dakotas and Montana.

The week ending September 11 was moderately cool at the beginning over the western mountains, and again near the end in nearly the same districts, both cool areas extending slowly eastward, but largely losing their

identity as they approached the Atlantic seaboard. In the far West this period was distinctly warm, the averages for the week ranging up to 12° above normal in the interior of California, the 7th and 8th being particularly warm, with the highest temperatures ever observed in September at a number of points in California, Oregon, and Nevada. In the central and eastern districts the temperatures for this week were mainly near the normal.

The week ending the 18th, being mainly under the influence of high barometric pressure over the northern and central districts from the Rocky Mountains eastward, was cool throughout this region, the weekly averages ranging from 3° to 9° below normal. About the 13th to 15th the coldest weather of the month was experienced over a large area from the Dakotas and Nebraska eastward to the Great Lakes, and during the 16th to 18th this cold area extended to the Middle and North Atlantic States. At a few points in the upper Mississippi Valley the minimum temperatures recorded during this period were the lowest ever observed in September. Along the Gulf coast, and westward to southern California, and generally over the Pacific Coast States this week was moderately warm. In California hot, drying winds on the 16th and 17th favored the spread of numerous forest and other fires, one of which, becoming beyond control, caused damage estimated at \$10,000,000 in the city of Berkeley.

A sharp return to more seasonable temperatures, following the cool week ending the 18th, occurred during that ending the 25th over the central and eastern districts, and moderately warm weather was the rule, although the first few days continued cool over the Northeastern States. In the far West the week was mainly cooler than normal, with a sharp drop near the end over the southern Plateau region. The last 5 days of the month continued warm over the districts east of the Rocky Mountains, while to the westward temperatures lower than normal were the rule.

The average temperature for the month was generally above normal throughout both the United States and Canada, save over extreme eastern Canada and the adjoining portions of Maine, over a narrow area from Louisiana northeastward to Lake Michigan, and over portions of the far Southwest, as indicated on Chart III. The departures both above and below normal were mainly small.

The warmest periods of the month for the different sections were confined mainly to the first decade, although in portions of the Ohio Valley and Tennessee the warmest period was about the 25th to 27th.

Maximum temperature of 100° or above were reported from nearly all the States from the Great Plains westward; the highest observed, 120°, occurred in southern California.

The coldest weather of the month in the districts east of the Rocky Mountains was confined largely to the period from the 13th to 18th, during which unusually high atmospheric pressure dominated the northern and central districts and severe frosts occurred during this period in portions of the principal corn-growing regions, considerable damage resulting to that crop in Iowa and in other States to the eastward where that crop as well as others had not fully matured.

PRECIPITATION.

Considering the country as a whole, the precipitation was above normal over the greater part, although there

were marked deficiencies in Tennessee and the Gulf States east of the Mississippi River, and moderate deficiencies in portions of the Northeastern States, the upper Lake region, and the far Northwest.

The precipitation was greatly in excess of the normal over most of the Great Plains States, the lower Missouri and middle Mississippi Valleys, and locally in Michigan, along the Texas coast, and at points in Arizona and California. In Oklahoma the severe drought of July and August was broken by the rains of the 1st and 2d, and the month, as a whole, was the wettest September of record; also in Kansas the month was close to the wettest of record, while in central and eastern Wyoming and the adjacent portions of Montana and South Dakota the excesses were locally large, due to heavy rains near the end of the month, causing much damage to transportation systems by washouts, and to agricultural interests by flooding of crops, injury to hay, etc. Heavy rains from the 16th to 18th in northeastern Arizona caused many washouts on highways and railroads of that locality and much other property damage. In California showers during the last decade broke the long dry spell in that State.

Over the Atlantic coast districts, where more or less severe drought had existed during several preceding months, good rains were the rule and the monthly amounts were usually in excess of the normal, but on account of the previous deficiency the water supply continued short, although the surface supply was sufficient for agricultural needs.

In the East Gulf and the South Atlantic States there was a marked deficiency in precipitation as compared with the normal, and late crops and truck were suffering for rain, and the water supply for power purposes was reported in many instances as being insufficient. At some points in these districts the total fall for the month was the least of record for September, notably at Montgomery, Ala., where only 0.12 inch occurred during the entire month, the least in more than a half century of record.

SNOWFALL.

Only light snow occurred at any of the lower elevations. At points in the upper Lake region the light snows about the 12th were the earliest of record for that section and the first snow of the season was reported at a few points in New York.

In the mountains of California the first snow of the season occurred during the last decade, when amounts from 14 to 20 inches fell above the 5,000-foot level, but this soon melted except at the higher elevations. At Modena, Utah, the snow of the 27th, 0.7 inch, was the heaviest ever observed at that place so early in the season. Considerable snow fell in some of the high mountains of Nevada, Utah, and Wyoming and other parts of the Rocky Mountains.

RELATIVE HUMIDITY.

Like precipitation, the relative humidity was above the normal over the greater part of the country, the excess over the middle and southern Great Plains and adjacent regions ranging from 5 to 10 per cent. In the dry region of the East Gulf and South Atlantic States there was a moderate deficiency and like conditions occurred over the northern border States from Minnesota to Washington, and locally in Oregon and California.

SEVERE LOCAL STORMS, SEPTEMBER, 1923.

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.]

Place.	Date.	Time.	Width of path (yards).	Loss of life.	Value of property destroyed.	Character of storm.	Remarks.	Authority.
Cairo, Ill.....	3	3:00-3:17 p. m.	.....	.....	.....	Tornado.....	No damage reported.....	Official, U. S. Weather Bureau.
Atlantic City, N. J.....	4	4:40-7:00 a. m.	.....	.....	.....	Thunderstorm.....	One house struck by lightning. No other damage reported.	Do.
Marinette, Ariz.....	12	.....	.....	.....	.....	Rain and wind.....	Cotton damaged and tents blown away.....	Do.
Miami, Fla.....	13	10:34 a. m.-12:33 p. m.	.....	.....	.....	Thunderstorm.....	Streets flooded and some damage caused by lightning.	Do.
Berkeley, Calif., and vicinity.	16-17	.....	.....	.....	\$10,000,000	High winds.....	Grass and forest fires becoming beyond control entered into the city of Berkeley, causing great damage.	Do.
Oklahoma City, Okla.....	18	6:02-8:40 p. m.	.....	.....	1,000,000	Hail, rain, and wind.	Heavy property damage; many persons injured by hail.	Do.
Harvey and Sedgwick Counties, Kans.	26	6:00 p. m.-12:00 midnight.	.....	.....	210,000	Tornado and rain..	Heavy property damage by wind and floods. Two persons injured.	Do.
Pine Bluff, Wyo. (near Cheyenne, Wyo. (10 miles southeast of).	27	p. m.	.....	.....	8,000	High winds.....	41 empty freight cars blown from track.....	Do.
Albany, N. Y., and vicinity..	27	.....	.....	.....	.....	Wind and rain....	Buildings and fences blown down and much farm machinery damaged.	Do.
Council Bluffs, Iowa (southeast part of).	28	.....	.....	1	.....	Electrical.....	Some livestock killed.....	Do.
	28	7:50 p. m.	.....	5	15,000	Tornado.....	Path several hundred feet wide, not exceeding 3 miles in length; 1 house demolished and a number damaged to varying extent. Trees uprooted. Extensive damage in city by floods.	Do.

STORMS AND WEATHER WARNINGS.

WASHINGTON FORECAST DISTRICT.

By EDWARD H. BOWIE, Supervising Forecaster.

At the beginning of the month the storm reported during the closing days of August as having formed to the eastward of the island of St. Martin, West Indies, was moving northwestward and on the 2d and 3d it produced strong winds and considerable rainfall in the vicinity of Bermuda. Its center apparently passed northward immediately west of Bermuda and thence its course was to the northeast, but being unable to continue to move northeast against the current flowing from an area of high barometric pressure to the northward it changed its course to the westward and finally again to the northward, so that on the 9th the center of the disturbance was south of Sable Island, from which position it moved northward to Newfoundland. Shipping was kept advised by means of radio as to the presence and movement of the disturbance.

During the 14th another disturbance but of extratropical origin formed off the coast between Cape Hatteras and Bermuda and moving northeastward increased greatly in intensity, passing beyond Newfoundland on the 19th. As in the former instance shipping was well advised by radio concerning the movement and intensity of this disturbance.

Following this disturbance the weather off our eastern and southern coasts remained relatively tranquil until the 25th, when reports by cable from the West Indies and radio reports from vessels at sea gave unmistakable indications of the forming of a disturbance northwest of Haiti. Based on the observations received at 8 p. m. of the 25th, the following advice was issued to ports and for broadcast by radio:

Disturbance apparently over Old Bahama Channel will move west-northwest and increase in intensity. Vessels in Bahaman waters and Florida Straits should exercise every precaution.

As forecast, this disturbance advanced west-northwestward and the morning of the 26th its center was near and southeast of Nassau, Bahamas, where the pressure was 29.54 inches, the wind northwest 40 miles, and the weather raining. Continuing to advance slowly, this disturbance moved northwestward during the next 24 hours

and then its course changed to north and northeastward and by 8 a. m. of the 28th its center was in approximately lat. 32° N. and long. 75° W. and moving northeast. During the following 24 hours this disturbance moved eastward and during the night of the 29th its course changed to northeast and on the morning of the 30th its center was near lat. 33° N. and long. 69° W. From this position its course was north-northeastward, and on October 2 its center passed over Newfoundland.

This disturbance was one of great intensity and very low level of the barometer. The lowest pressure reported was approximately 28.50 inches, while several vessels reported winds of hurricane force. Because of its having been detected in the process of formation and its path and intensity having been accurately described in special advices by radio to vessels at sea, minimum amount of damage was done to shipping. Moreover, since the center of the disturbance did not reach the coastal line, no extraordinary wind and weather conditions were recorded at land stations. Nevertheless, and to guard against vessels in port putting out to sea, storm warnings were displayed on the Atlantic coast in connection with this storm at all points at and south of the Virginia Capes, and on the afternoon of the 26th when the disturbance was moving northwestward and its center near Nassau, hurricane warnings were displayed along the coast at and between Savannah, Ga. and Jupiter Inlet, Fla.; but the following morning when observations showed that the disturbance would move northward, these hurricane warnings were lowered and northeast storm warnings substituted.

That the advices issued were greatly appreciated and of direct benefit to shipping off the Atlantic coast, the following extracts from letters received will attest. These letters were addressed to the New York office of the Weather Bureau. They follow.

From the general manager, marine department of the United Fruit Co. (dated October 9, 1923):

I wish to thank you, on behalf of the United Fruit Co., for the service which you rendered us during the recent hurricane. Your various reports and the information submitted by you were greatly appreciated by all concerned. (Signed) Asa F. Davison.

From the manager of the marine department, Standard Oil Co. of New Jersey (dated September 26, 1923):

I wish to thank you for your telephone advice of this noon that a hurricane is central this morning near Nassau, moving northwest, across